

Application No. 10/735,845

Docket No.: 20140-00314-US

REMARKS

Reconsideration of claims 1, 3-11 and 24-29 is respectively requested. Claims 11 and 29 are amended. Previously withdrawn claims 12-23 are Canceled.

The objection to claim 5 suggesting that the term "a" be inserted before "gaseous" is respectfully traversed. The claim, as written, is proper under 35 USC 112, second paragraph.

The objection to claim 7 as including an improper Markush group is traversed. Applicants submit that the Markush group is properly presented in the Original claim. The examiner is directed to MPEP 2173.05(h) which makes no mention of a requirement to include the term "at least one" as proposed. The claim, as written, is proper under 35 USC 112, second paragraph.

The rejection of claims 11 and 29 under 35 USC 112, second paragraph is respectively traversed with respect to the amended claims.

The rejection of claims 1-4, 6, 7, 9 and 10 under 35 USC 102(e) as anticipated by Cooney (2004/0152295) is respectively traversed. The rejection is based entirely on a factual conclusion that the "second liner layer 9", as described in Cooney corresponds to the term "interconnect copper line" in the claims. Applicants respectfully submit that this factual conclusion is incorrect, and therefore the rejection is improper.

Cooney describes conventional interconnect structures with conductive wires embedded in a dielectric material (see, para. 0004) having a barrier or liner structure (see, para. 0008). Cooney goes on to emphasize the "need in the industry for an improved liner structure, particularly for copper metallurgical structures," See, para. 0009. The copper metallurgical structures referred to in Cooney corresponds to the term "interconnect copper line" in applicants' claims, and not the "improved liner structure" as stated by the rejection. Cooney describes the improved liner structure as having a first liner layer, which protects the via sidewalls from erosion during processing, and a second liner layer, which increases the contact area of the underlying metallization. See, para. 0010.

In further support of applicants' argument that the "second liner layer 9" is not the claimed "interconnect copper line", one need only look to the disclosure of Cooney itself. In

Application No. 10/735,845

Docket No.: 20140-00314-US

fact, the title alone, "Sacrificial Metal Liner For Copper" makes this distinction. In paragraph 10, and throughout Cooney, other distinctions are made between copper interconnect lines and a liner structure.

Further, during sputter etching or cleaning, the first liner layer is removed from the via bottom, to avoid interconnect contamination during processing and to further enhance reliability. ... The liner structure also improves stress migration characteristics, which are particularly problematic in copper interconnects. Para. [0010]

Next, a second liner layer 9 is deposited, generally conformally, over the dielectric layer 4 and in the via 5, on the first liner layer 6 left on the via sidewalls 7 and on the extended portions of the sidewalls 7 and the bottom 8 penetrating the metal line 2, as shown in FIG. 1E. The second liner layer 9 preferably comprises a refractory metal or a compound thereof, more preferably, tantalum, tantalum nitride, titanium, titanium nitride, a titanium-tungsten alloy or a combination thereof. ... Referring to FIG. 1F, after removal of the second liner layer 9 from the dielectric layer 4, such as by CMP, a conductive material 10 deposited, as to fill the via 5, as well as coating the top surface of the dielectric layer 4. Para. [0024-25]

Cooney tells one of ordinary skill that the conductive material 10, and not the second liner layer 9, refers to an interconnect copper line, as claimed.

Like the interconnect structures described in Cooney, the interconnect structures described by applicants can contain one or more barrier layers "between the dielectric material and the conductive material in order to prevent atoms of the conductive material from diffusing into and at times through the dielectric material." The presence of the barrier layers minimize inter-level or intra-level shorts and junction leakage. Page 2, lines 4-10. "As a result, if copper is used as an interconnect structure, the copper needs to be confined with a barrier layer." Id., lines 15-16. The application further describes the process steps commonly used to provide a copper interconnect line. See, Figs. 1A to 1C, which show a trench 14, via 15, copper line 12, and barrier layer 16. A copper plating process is then used to fill the trench thereby forming another interconnect copper line. Id., lines 17-29.

The rejection improperly points to the "second liner layer 9 as the claimed "interconnect copper line". One of ordinary skill in the art with the knowledge provided by Cooney and from reading the entirety of the application would no doubt differentiate between an interconnect

Application No. 10/735,845

Docket No.: 20140-00314-US

copper line and a barrier layer in a semiconductor interconnect structure. Accordingly, Applicants respectfully request that the rejection be withdrawn.

The rejections of selected claims under 35 USC 103 as unpatentable over Cooney in view of the listed secondary references is respectively traversed as the secondary references do not overcome the stated deficiency in Cooney.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 50-0510, under Order No. 20140-00314-US from which the undersigned is authorized to draw.

Dated: January 17, 2006

Respectfully submitted,

By 

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